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VOLUME XIX. SAN FRANCISCO, CAL., DECEMBER 21, 1907 No. 25

A TABLE OF RAINFALL.

By Alexander McAdie, Professor U. S. Weather Bureau.

On this page is presented a tabular statement of the rainfall during a period of fifty-eight years as given by the U. S. Weather Bureau office at San Francisco. The early records were made by Mr. Thomas Tennent and by Mr. John Pettee. While the location of the measuring gage has been moved from time to time, the record is fairly consistent as a whole. Some comparisons of the catch of the earlier gages with those of the Weather Bureau gages between 1871-1880 show a general agreement sufficiently close for most purposes. As from time to time the elevation of the rain gage was increased, it was found that the catch diminished. Owing to eddy, or wind current effects, the gage on the roof of the Mills Building caught less than a similar gage on the roof of the old Russ House, and presumably about one-third less than the catch would have been had the gage been located near the ground in an open park. I have therefore, while not altering the figures giving the actual catch, corrected the seasonal values, beginning in 1891-2—the year of moving into the Mills Building. This correction brings the seasonal rainfall at San Francisco in excess of 24 inches, which is certainly not over the true amount that falls.

An inspection of the table will show first that the seasonal totals have varied from 49.27 inches to 7.42 inches, or the maximum fall has been twice the average and the minimum as low as one-third of the average. In fifty-eight seasons there have been four, when half or less than the normal amount fell. The dry

SAN FRANCISCO RAINFALL, MONTHLY, SEASONAL AND ANNUAL, 1849–1907.

Season.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Seasonal	Year	Annual
1849–50	0	0	0	3.14	8.66	6.29	8.34	1.77	4.53	0.46	0	0	33.10	1850	17.40
1850–51	0	0	0.33	0	0.92	1.05	0.72	0.54	1.94	1.23	0.67	0.02	**7.42**	51	15.60
1851–52	0	0.02	1.03	0.21	2.12	7.10	**0.58**	0.14	6.68	0.26	0.32	0	18.46	52	27.29
1852–53	0	0	0	0.80	5.31	13.20	3.92	1.42	4.86	5.37	0.38	0	35.26	53	21.17
1853–54	0	0.04	0.46	0.12	2.28	2.32	3.88	8.04	3.51	3.12	0.02	0.08	23.87	54	22.45
1854–55	0	0.01	0.15	2.43	0.34	0.87	3.67	4.77	4.64	5.60	1.88	0	23.76	55	26.39
1855–56	0	0	0	0	0.67	5.76	9.40	0.50	1.60	2.94	0.76	0.03	21.66	56	22.31
1856–57	0.02	0	0.07	0.45	2.79	3.75	2.45	8.59	1.02	**0**	0.05	0.12	19.91	57	20.96
1857–58	0	0.05	0	0.93	3.01	4.14	4.36	1.83	5.55	1.55	0.34	0.05	21.81	58	23.46
1858–59	0.05	0.16	0	2.74	0.69	6.14	1.28	6.32	3.02	0.27	1.55	0	22.22	59	21.39
1859–60	0	0.02	0.03	0.05	7.28	1.57	1.64	1.60	3.99	3.14	2.86	0.09	22.27	1860	21.18
1860–61	0.21	0	0	0.91	0.58	6.16	2.47	3.72	4.08	0.51	1.00	0.08	19.72	61	25.52
1861–62	0	0	0.02	0	4.10	9.54	**24.36**	7.53	2.20	0.73	0.74	0.05	**49.27**	62	38.63
1862–63	0	0	0	0.52	0.15	2.35	3.63	3.19	2.06	1.61	0.23	0	13.74	63	15.10
1863–64	0	0	0.03	0	2.55	1.80	1.83	**0**	1.52	1.57	0.78	0	10.08	64	21.64
1864–65	0	**0.21**	0.01	0.13	6.68	8.91	5.14	1.34	0.74	0.94	0.63	0	24.73	65	14.06
1865–66	0	0	0.24	0.26	4.19	0.58	10.88	2.12	3.04	0.12	1.46	0.04	22.93	66	36.28
1866–67	0	0	0.11	0	3.35	**15.16**	5.16	7.20	1.58	2.36	0	0	34.92	67	30.64
1867–68	0	0	0.04	0.20	3.41	10.69	9.50	6.13	6.30	2.31	0.03	0.23	38.84	68	30.17
1868–69	0	0	0	0.15	1.18	4.34	6.35	3.90	3.14	2.19	0.08	0.02	21.35	69	22.59
1869–70	0	0	0.12	1.29	1.19	4.31	3.89	4.78	2.00	1.53	0.20	0	19.31	1870	16.24
1870–71	0	0	0.03	0	0.43	3.38	3.07	3.76	1.31	1.89	0.23	0.01	14.11	71	27.53
1871–72	0	0.02	0	0.07	2.81	14.36	4.00	6.90	1.59	0.81	0.18	0.04	30.78	72	22.42
1872–73	0.01	0	0.04	0.11	2.79	5.95	1.58	3.94	0.79	0.43	0	0.02	15.66	73	18.56
1873–74	0.01	0.08	0	0.83	1.16	9.72	5.66	2.21	3.36	0.90	0.66	0.14	24.73	74	22.52
1874–75	0	0	0.02	2.69	6.55	0.33	8.01	0.32	1.30	0.10	0.22	1.02	20.56	75	22.63
1875–76	0	0	0	0.24	7.27	4.15	7.55	4.92	5.49	1.29	0.24	0.04	31.19	76	23.54
1876–77	0.01	0.01	0.38	3.36	0.25	**0**	4.32	1.18	1.08	0.26	0.18	0.01	11.04	77	11.93
1877–78	0.02	0	0	0.65	1.57	2.66	11.97	**12.52**	4.56	1.06	0.16	0.01	35.18	78	33.26
1878–79	0.01	T.	0.55	1.27	0.57	0.58	3.52	4.90	**8.75**	1.80	2.35	0.05	24.44	79	30.76
1879–80	0.01	0.02	T.	0.78	4.03	4.46	2.23	1.87	2.08	**10.06**	1.12	0	26.66	1880	30.07
1880–81	0	0	0	0.05	0.33	12.33	8.69	4.65	0.90	2.00	0.22	0.69	29.86	81	23.73
1881–82	0	0	0.25	0.54	1.94	3.85	1.68	2.96	3.45	1.22	0.21	0.04	16.14	82	18.67
1882–83	0	0	0.26	2.66	4.18	2.01	1.92	1.04	3.01	1.51	**3.52**	0.01	20.12	83	15.43
1883–84	0	0	0.42	1.48	1.00	0.92	3.94	6.65	8.24	6.33	0.23	**2.57**	32.28	84	**38.82**
1884–85	T.	0.04	0.33	2.55	0.26	7.68	2.58	0.30	1.01	3.17	0.04	0.19	18.10	85	23.18
1885–86	0.05	T.	0.11	0.72	**10.06**	4.99	7.42	0.24	2.07	5.28	0.37	0.01	31.33	86	20.02
1886–87	**0.23**	T.	0.01	1.48	0.84	2.07	1.90	9.24	0.84	2.30	0.06	0.07	19.04	87	19.04
1887–88	T.	0.01	0.29	T.	0.99	3.34	6.81	0.94	3.60	0.11	0.38	0.47	16.74	88	23.03
1888–89	0.01	0.01	0.98	0.13	3.99	5.80	1.28	0.72	7.78	0.96	2.17	0.03	23.86	89	36.94
1889–90	0.01	T.	T.	**7.28**	2.90	13.81	9.61	5.16	4.73	1.18	1.07	0.10	45.85	1890	25.43
1890–91	0.02	0	0.31	0	**0**	3.25	0.98	7.26	1.96	2.44	1.25	0.11	17.58	91	21.11
1891–92	0.10	0.02	0.77	0.04	0.56	5.62	2.42	2.90	2.85	1.30	1.86	T.	18.53	92	22.08
1892–93	0	0	0.02	1.65	3.91	5.08	3.05	2.75	4.08	1.03	0.15	0.03	21.75	93	17.91
1893–94	0.02	0	0.21	0.16	4.18	2.25	5.99	2.69	0.60	0.50	1.31	0.56	18.47	94	24.32
1894–95	T.	0	1.05	1.73	2.88	9.01	6.99	2.31	1.89	1.24	0.69	0	25.70	95	17.13
1895–96	0.01	0	0.77	0.11	1.78	1.43	8.14	0.28	2.85	5.16	0.72	0	21.25	96	28.25
1896–97	0.04	0.09	0.52	1.55	4.56	4.34	2.26	4.41	4.56	0.27	0.61	0.22	23.43	97	16.40
1897–98	T.	T.	0.10	1.70	1.05	1.22	1.12	2.13	**0.24**	0.19	1.44	0.19	9.38	98	**9.31**
1898–99	0	T.	1.06	0.86	0.46	1.62	3.67	0.10	7.61	0.62	0.86	0.01	16.87	99	23.23
1899–1900	0	T.	0	3.92	3.79	2.65	4.11	0.64	1.91	1.08	0.32	0.05	18.47	1900	15.33
1900–01	T.	T.	0.46	1.48	3.91	1.37	5.79	5.03	0.80	1.64	0.69	T.	21.17	01	19.75
1901–02	T.	T.	0.78	0.64	3.48	0.90	1.23	7.27	2.65	0.98	1.05	T.	18.98	02	19.18
1902–03	T.	T.	T.	1.70	1.98	2.32	3.73	1.76	6.23	0.56	T.	T.	18.28	03	18.33
1903–04	0	T.	T.	0.17	4.25	1.63	1.05	5.89	6.01	1.29	0.30	T.	20.59	04	24.72
1904–05	0.02	0.06	**5.07**	2.37	1.07	1.59	4.04	2.70	3.15	1.33	2.05	0	23.45	05	16.24
1905–06	0	T.	T.	T.	0.92	2.05	3.90	4.30	5.02	0.92	2.75	0.56	20.42	06	28.34
1906–07	0.08	0.11	0.18	0.03	1.59	6.90	4.41	3.02	8.42	0.11	0.04	1.28	26.17	07	.....
Average (58 years) ...	0.02	0.02	0.30	1.02	2.66	4.68	4.72	3.54	3.37	1.74	0.75	0.16	22.98	.....	22.77

seasons as a rule are due to scant rain in mid-winter; and the wide range of California rainfall is strikingly illustrated by the fact that there has been a November without any rain, also a December and March. On the other hand as much as 15 inches have fallen in a single December; 24 inches in January and 12 inches in February. The winter of 1861-2 may be considered as the wettest, over 45 inches of rain falling in four months. No law can be formulated regarding periodicity in rainfall. Dry seasons are not necessarily followed by wet seasons, nor vice versa. A dry period may extend over several months and on the other hand a dry period will sometimes occur between a December of heavy rainfall and a March of heavy rain.

So much for the intensity or amount of rain. With regard to frequency or time distribution we may count upon an average of nearly seventy rainy days in the year, the extremes being 107 days in the season of 1889-90 and thirty-seven days in the season of 1863-4.

Considering the relative monthly frequency, we find the average number of days in January to be eleven; February, ten; March, ten; April, six; October, four; November, seven, and December, eleven. And the balance scattered, although July and August are practically without rain.

The greatest number of rainy days (twenty-four) occurred in December, 1889. In January, 1890, there were twenty-three days; also in March, 1904, twenty-three days with rain.

The maximum rates of rainfall are as follows: Five minutes, 0.19 of an inch; ten minutes, 0.32.

The heaviest twenty-four-hour rainfall occurred between 11 P. M., January 28, and 11 P. M., January 29, 1881, when 4.67 inches fell.

On September 23, 1904, 2.39 inches fell in sixteen hours and fifteen minutes; the total in twenty-four hours being 3.09 inches. If due allowance be made for difference in elevation of the gages, the rainfall of September 23, 1904, must be considered the heaviest twenty-four-hour rainfall in San Francisco, with the one exception above noted. But what is particularly significant in the September rainfall is this: that in fifty-five years there had been no September rainfall exceeding 1.06 inches, and there was no reasonable expectation of an amount of rain equal to that record. This is interesting as showing that engineers must be guarded in statements concerning probable maxima and minima falls and resulting run-offs. Estimates based upon short term records, especially in mountain sections, or where water storage sites are under discussion, must be taken with due allowance.

COPPER MARKET SITUATION.

Dullness again rules the market, and the recent show of firmness was of too short duration to keep prices up to 15 cents, to which level they were temporarily lifted in the effort to promote business. Large sales were reported in October, and if they all represented transactions with melters there might be something substantial upon which to base a renewal of firmer expectations.

But a movement that has to rely to a great extent for its success on speculative operators in London for carrying it through is hardly likely to be of a character that will impress the actual consumer very favorably. We know there may be heavy sales of copper reported under the rules governing standard contracts, or as warrants, which mean in many cases nothing more or less than paying differences on dates of settlements, as contracts mature without the passing over of the actual metal for consumption.

There has undoubtedly been a fair amount of copper taken by England and Germany for manufacturing purposes, but would it not be interesting to know what percentage of the unusually heavy exports shipped during the past six weeks has gone abroad on speculation or for the purpose of being more easily financed than was possible here in the United States. Before we believe in the soundness of the copper situation we want to be assured that at least 75 per cent of the producion is going into the crucible, and that the surplus stocks have passed into consumption. Manufacturers of wire and brass goods are concerned chiefly in fostering trade conditions that will permit the sale of their products without being obliged to run an undue degree of risk through wholesale cancellations coming back to them in bunches every time the copper market records a slump.

With curtailment in manufacture, discharge of workmen, and an acute financial situation seriously affecting credit, we cannot discover any justification for putting up the price of raw material. We are fully convinced the time will come when business will recover its lost nerve, and when that time comes it will make little difference whether the market price for copper is 14 or 16 cents so long as it rests on a stable foundation. Ability to take his orders and fill them at the stipulated terms are the ideal conditions which the manufacturer aims to bring about. From our viewpoint we believe the situation justifies the foregoing statements, and as distributors of copper in manufactured form in many directions we meet propositions which neither the producer, merchant, nor speculator is called to face. It is by wise co-operation and consulting the good of all concerned that all the recent difficult problems which have arisen will be solved right, and the unsound timbers in both the ship of state and the financial structure will be discarded for the true and tried material worthy to stand the severest tests.

There is much necessary work to do before industrial interests will be in secure position, and if done too hastily it may have to be done over again. Confidence must be increased by a thorough clearing up of the financial situation and the eradication of whatever savors of mere manipulation for the purpose of blinding the business public. We have passed through a perilous experience lately, and no patchwork job will stand. As things are at present it is no time for planning bull campaigns. Sober action is required to extricate the country from an unpleasant predicament. In the midst of the recent unfortunate financial situation there came the flurry in the price of copper, when during the three worst days of our money troubles the metal advanced 25 per cent, a most unprecedented advance, length of time considered, and at that without any apparent reason. Our only concern should be to know what has become of the immense volume of copper said to have been sold. If it shall develop that it has not been all sold, but shipped or "sold" abroad for purposes of finance, these bills must some day become due. If, on the other hand, the material shall have gone into the hands of speculators, at some future day what if there should be 100 sellers where a month ago there were but ten. Certain it is that with lack of money new enterprises have not taken the copper, and without new enterprises no such amount of metal could be consumed as is claimed to have been sold. No new undertaking should commit itself for material until it is financed to the limit, since for a long time to come investors will look with suspicion on anything not tried and known. We may see a great surplus of money during the first months of 1908, but bankers will necessarily guard it with jealous care lest we precipitate a state of affairs like the present. Everything considered, and the poor outlook for an early improvement in business, we ask should present prices hold? Other phases of the situation might be considered, such as the reduction in output to prevent further accumulation, and the postponement of new enterprise until financial accommodations are obtainable, but in the present temper of business conditions it will take a long time to bring about a restoration of confidence. As things are now we are not surprised that copper has declined from 15. Bottomed on sound conditions these prices would not be considered high, but until the market gets on a solid foundation we believe the safe course for the consumer is the conservative one.—Copper Gossip.

ADVANTAGES OF SINGLE-PHASE DISTRIBUTION.

The central station with its auxiliary distribution system is a manufacturing plant, to which the same general principles of investment in equipment and operation apply, as to any other form of factory, hence there must be the greatest possible simplification of output; the production must be on as nearly a uniform basis as possible; and the full productive capacity must be sold to insure the best returns on the investment.

The prevailing tendency of central station engineers has been to follow the practice of others, and after a slight investigation discloses the fact that multiphase generators are cheaper than single-phase generators, and that the saving in copper on a multiphase transmission line is about 25 per cent, they install multiphase generators and feeders irrespective of the size of the plant, the territory to be covered, or the probable maximum size of motor that might be installed on their circuits, with the result that many have come to realize that their investment has greatly exceeded what was actually necessary to enable them to render satisfactory service to their customers.

The following arrangement of central station service is suggested as a most satisfactory system:

(A) **For large plants**—Polyphase generators with:

First—Polyphase feeders for all large power and rotary converters.

Second—Single-phase feeders for all general lighting and small motors, the switch board being arranged to permit a feeder being switched on to any phase of the generator.

Third—Feeder regulators for all polyphase and single-phase feeders.

(B) **For small stations.**

First—Either polyphase generators, with single-phase feeders, which may be switched onto any phase of the generator, and each feeder provided with an independent pressure regulator, or

Second—Single-phase generators and each feeder provided with an independent pressure regulator.

The principal advantages of single-phase distribution are simplicity, flexibility and saving in the cost of supplying current to the consumer. The chances of breakdowns are reduced in direct proportion to the number of wires used to transmit the current.

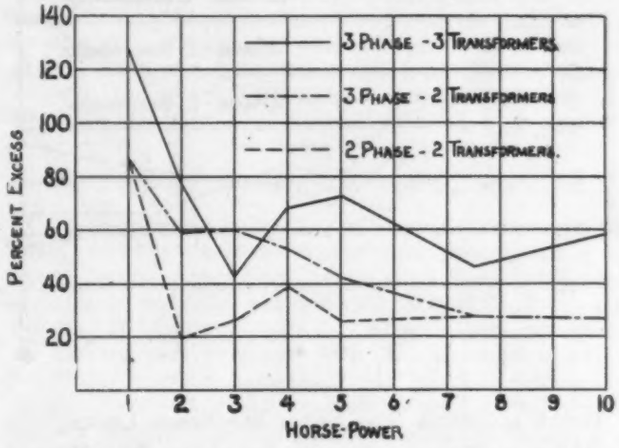
If polyphase motors are used exclusively the flexibility of the system is reduced to a minimum. Single-phase motors on existing lighting lines mean maximum flexibility. Usually the lines that are run to new territory are single phase. First lighting business is taken on, then these customers want power, which should be single phase, as scattered power cannot be profitably connected, if one or two more primary wires have to be run to the customer.

By distributing current single phase, there is a saving in the cost of the line. The fact that power can be transmitted, with the same loss, with 25 per cent less copper, three phase than single phase must not be the deciding factor. The cost of insulation must be paid, for which brings the saving to about 15 per cent actual. Then the extra labor installing the third wire, brackets, insulation, etc., must receive consideration.

On a polyphase system, the problem of balancing is simplified, because of the even loading of the phase, but single-phase distribution from polyphase generators is not a serious objection to single-phase distribution if properly carried out. The chances are that the motor load will be evenly balanced if a little care is exercised in connecting them to the proper phases.

It is a fact that single-phase motors cost more than multiphase motors, but not so much more as to make it probable that the usual customer having to use power cannot afford to pay it, and if the solicitor is any kind of a salesman he should not have any trouble in convincing the customer of the advantage and advisability of paying this extra price, rather than purchasing a gasoline or steam engine.

It is not always advantageous for the central station to supply multiphase current to their customers, even though they may have their multiphase line in the immediate vicinity of the prospective customer. Many central stations have found this to be true, and some of the strongest advocates of single-phase motors are central station managers having multiphase generators only, who concede the great advantage of installing single-phase motors in many places and the only difference of opinion between them is as to the limit in size they will permit to be installed on ther multiphase circuits. The size of motor that the various central stations permit to be installed on their circuits is usually governed by the local conditions, such as the amount of load on the various phases of either or both the generator and secondary network of distribution in concentrated districts, the location of the motor with respect to the station and the load in that vicinity, and the peculiar notions of the individual.



CURVES ILLUSTRATING EXCESS COSTS OF TRANSFORMERS FOR MULTIPHASE MOTORS AS COMPARED WITH SINGLE-PHASE MOTORS.

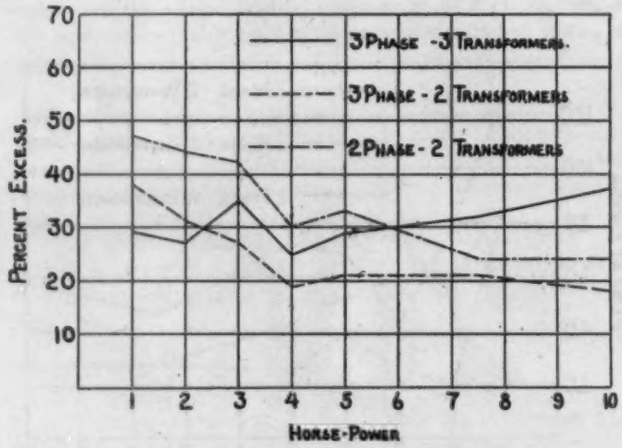
FIG. 1.

Other reasons that the central station manager should require that his customers use single-phase motors, are that, unless the load is of such magnitude as to seriously disturb the regulation on the different phases of the generator, it is an unnecessary investment and an unnecessary expense to the central station to prepare to furnish current to an individual multiphase motor installation. If proper attention is given to making installations on different phases, no serious effect will result from unbalancing.

The cost of one transformer to operate a single-phase motor is less than the two or three smaller transformers required to operate a multiphase motor. You will note by Fig. 1 that this excess first transformer cost averages about 25 per cent for two-phase motors and about 50 per cent for three-phase motors operating on two transformers. You will readily appreciate that this will amount to a large unnecessary investment, where a large number of installations are made. A much less transformer core loss will naturally result where only one transformer is used, and consequently a much higher transformer efficiency. A comparison of transformer losses is given in Fig. 2, and is based on standard transformers of a prominent make. When only two transformers are used to furnish current to a three-phase motor considerable care must be used not to overload the transformers, as a full energy load on the transformers gives a current overload of approximately 15 per cent with a consequent copper loss of approximately 30 per cent in excess of full-load copper losses. As shown by Fig. 2, the average transformer losses for two transformers for a three-phase motor exceed those of one transformer for a single-phase motor, an average of about 30 per cent.

A further saving of considerable amount is usually effected in a single-phase installation by the need for only one single-phase recording watt meter, while in a multiphase installation, which is usually made up of both motors and lights or other single-phase apparatus, either two single-phase meters or an expensive polyphase meter is needed. Installations of a single-phase meter on a straight polyphase motor load, and using a constant to arrive at the total power consumption, is in use in only remote cases.

In making a single-phase motor installation only two wires, a less number of fixtures, such as insulators, fuse blocks, a two-pole switch and less labor will be required to install not only the transformers, but the motor as well. The excess cost to the central station for equipment necessary to



Curves Illustrating Total Excess Transformer Losses for Multiphase Motors as Compared with Single-Phase Motors.

FIG. 2.

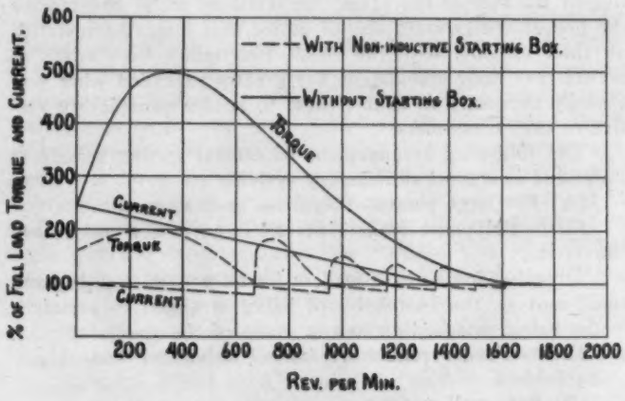
furnish current to a five-horsepower 208-volt three-phase motor installation, where the transformers are located only fifty feet from the meter, is about $48. If the central station furnishes the wiring inside the building to the motor, located only thirty feet from the meter, the total excess is about $54. As the average power bill for a five-horsepower motor is only $15 per month, and assuming that of this amount 25 per cent is net profit, it will take the central station about fourteen months to pay for this increased investment from such an installation. In addition to this, as cited before, there is the excess transformer losses going on all the time.

This increased investment is all right, in a way, but as a usual thing the central station manager has a hard time to make a creditable financial showing, and that the stockholder is not so much interested in seeing the value of his holdings increase due to an increased amount of equipment (the value of which is constantly decreasing) as he is in getting regular and good-sized dividends. These features alone are especially worthy of note where motors are required on the outskirts of a system of distribution as they cannot consistently be neglected by the central station manager.

Many central station managers are particularly impressed with the ease with which the starting current of the repulsion induction form of single-phase motor can be controlled by means of a non-inductive starting box, which differs only slightly from the familiar direct-current motor starting box. The judicious use of this non-inductive starter enables the use of large size motors without injurious unbalancing effects on a polyphase system, as it permits this type of motor to start under full load, with a current consumption of not to exceed 25 per cent in excess of full-load current and with a power factor from 70 per cent to 80 per cent, depending on the size of the motor.

On the other hand, a polyphase motor requires a more complicated form of starter, which if in the form of resistance, owing to having two or three circuits to control instead of one, is of a rather complicated character, and if they are not in the form of resistance they are not nearly so effective.

If this type of single-phase motor is started without a starter in circuit, it will not take more than 250 per cent of full-load current from the line when the switch is first closed, and during acceleration will develop at certain periods a torque of approximately 500 per cent of full-load torque, while with some makes of multiphase motors of three-horsepower and smaller, started without any auxiliary starting device, they will take 500 per cent of full-load current and only develop at starting a maximum of 125 per cent of full-load torque. Larger sizes are invariably provided with some form of starter either external or internal, as without they would take so much current as to make their installation prohibitive in most cases.



Starting Characteristic of Repulsion-Induction Single-Phase Motor.

FIG. 3.

Some central stations have a three-phase secondary system of distribution fed from several banks of transformers and all tied together in the congested business district, and they limit the single-phase motors to five-horsepower sizes in that district. In other cities they allow larger motors on such circuits, using, of course, some care in connecting the load to different phases so as to have each phase carrying as nearly equal a load as possible, but even in such places there are many installations where it is undesirable to use a multiphase motor for some classes of service, even though the multiphase secondary circuits are at hand, such as automatic pumping outfits for sprinkler systems used for fire protection, house pumps, pumps used for automatically handling seepage and sewage in basements, etc. Automatic starters are on the market for use with multiphase motors, but the results are not always satisfactory. On the other hand, the repulsion induction type of single-phase motors have the advantage of being able to develop an enormous starting torque without an excessive static current, consequently do not require any such complicated apparatus to insure their starting. Placed in the hands of the usually inexperienced operator, the repulsion induction type of single-phase motor will not cause any more line disturbance even when installed without a starter than the usual multiphase motor with an auto starter, because the operator is anxious to get the motor under way and if the fuses hold he will throw the lever on the starter over to running position in the shortest possible time.

The position taken by several prominent central stations, in regard to single-phase motors on their multiphase circuits is as follows:

Chicago distributes three phase four-wire, 3000 horsepower one phase, 19,000 horsepower three phase. Use one phase exclusively up to and including five-horsepower and no three-phase motors unless some in the plant are over five-horsepower.

Columbus, O.—Two phase. All sizes; larger sizes with non-inductive starters.

Public Service Corporation of New Jersey—Two and three phase. All sizes larger with starters.

Cleveland, O.—Three phase. Three-horsepower and less.

Brooklyn, N. Y.—Two phase. Five-horsepower and smaller and some larger depending on location.

New York City—Five-horsepower and smaller.

St. Louis—Three phase. All sizes, starters with three-horsepower and smaller.

Cincinnati, O., Covington, Ky., and Newport, Ky.—Single and three phase. Ten-horsepower and smaller requiring that two-horsepower and larger motors be 208 volts.

West Pennsylvania Electrical Company of Pennsylvania—Three phase. All sizes in some locations.

Birmingham, Ala.—Three phase. Three-horsepower and less; larger in some special cases.

Commonwealth Electrical Company, Chicago, Ill.—Three phase. Single phase up to five-horsepower, three phase in larger sizes. No three-phase motors allowed unless customer has other three-phase motors, five-horsepower or larger.

Alleghany County Light Company, Pittsburg, Pa.—Two and three phase. Ten-horsepower; larger sizes in special cases.

Denver Gas and Electric Company, Denver, Colo.—Three phase, with single-phase lighting feeders. As large as 25-horsepower where they are not used during the lighting peak.

Columbus Public Service Company, Columbus, O.—Three phase, four wire and single phase. Depends on location. Have as large as 35-horsepower.

Georgia Railway and Light Company, Atlanta, Go.—Single and three phase. Five-horsepower.

West Pennsylvania Electric Company, Connellsville, Pa.—Single and two phase. Three-horsepower; larger in special cases.

Kansas City Electric Company, Kansas City, Mo.—Single and three phase. Three-horsepower; larger in special cases, with starters.

Public Service Corporation of New Jersey, Newark, N. J.—Two and three phase. All sizes; large sizes with starters.

Cincinnati Gas and Electric Company, Cincinnati, O.—Single phase and three phase. Ten-horsepower.

Cleveland, O.—Three phase. Three-horsepower; larger in special cases.

Birmingham Railway and Light Company, Birmingham, Ala.—Three phase. Three-horsepower; larger in special cases.

Brooklyn Edison Company, Brooklyn, N. Y.—Two phase. Five-horsepower; larger sizes in some cases, with starters.

United Electric Light and Power Company, New York City.—Single and three phase. Five-horsepower.

Union Electric Light and Power Company, St. Louis, Mo.—Single and three phase. 7½-horsepower anywhere; starters with five-horsepower and larger; 10-horsepower and larger installed in most places.

The Edison Illuminating Company of Detroit, Detroit, Mich.—Single and three phase. Fifteen-horsepower largest allowed. With 7½-horsepower and larger starters are required.

San Francisco Gas and Electric Company, San Francisco—Two phase, 60 cycles. Three-horsepower.

City Electric Company, San Francisco—Two phase and single phase. Three-horsepower.

Edison Electric Company and Pacific Light and Power Company, Los Angeles—Three phase, two phase and single phase, 60 cycles. Five-horsepower.

Los Angeles Gas and Electric Company, Los Angeles—Three phase, two phase and single phase, 133 cycles. Five-horsepower.

Seattle Gas and Electric Company, Seattle and Tacoma Power Company and Municipal Light and Power Company, Seattle, Wash.—Three phase and single phase. Three-horsepower.

The single-phase motor is now to some extent entering the direct-current motor field for variable speed work such as the driving of ventilating fans, printing presses, machine tools, laundry machinery and other machinery requiring variable speed. This variable speed is accomplished by using a repulsion or series single-phase motor, and a resistance box or auto transformer. Single-phase motors have even entered into competition for traveling cranes, hoists, freight and passenger elevator service, and are said to be successful.

The single-phase interurban railway systems are entering the field very rapidly, on account of the lower cost of substation equipment and attendance, and the savings in many other ways that are effected over the old direct current system. As they get these lines distributed around the country they will be able to distribute current to the small towns, farmers, etc. Even though this current will be of low frequency it will give fairly satisfactory results for most kinds of lights except arc lights, and is entirely satisfactory for single-phase motors.

TESTS OF HICKORY BY FOREST SERVICE.

Those concerned in the use of hickory will follow with interest a series of tests of this valuable wood about to begin at the Forest Service timber-testing laboratory at Purdue University, at Lafayette, Ind. The importance of the tests lies in the fact that they will furnish accurate data on the relative strength on the different kinds of hickory, which is a wood for which no satisfactory substitute has been found. The hardwood forests of the northern section of the country are being rapidly denuded and it is therefore important that accurate information regarding like species in oher sections of the country be obtained. The hickory of the northern States has always been considered of better quality than that of the South, and has been quite generally given the preference by manufacturers and users of this species of wood. Prejudices once established are not readily removed, and because of this fact the Forest Service is preparing to prove conclusively the relative merits not only of hickory of the same species obtained in different sections of the country, but also different species of hickory grown in the same section. It is intended later to extend the scope of this work to other species of wood in the order of their importance to the manufacturing interest of the country.

A shipment of Southern hickory has just been received at the Purdue timber-testing laboratory. This material was collected by a representative of the Forest Service, and accurate data regarding species, growth, and locality were taken for each tree from which the material was obtained. Other material of the same species, to be selected, will be treated in a like manner and all will be tested for the purpose of determining its strength, stiffness, and suitability for the purposes for which it is used. The strength, stiffness, and other data obtained by these tests will make possible a direct comparison of the merits of the wood as regards its species and locality of growth.

A pinch in the hickory supply has been felt for several years, and it is already seen that the growing of hickory must be encouraged either by natural growth or artificial planting, if the permanence of a number of industries is to be insured. The importance of this first series of tests by the United States Forest Service lies in the fact that they will determine just what species of hickory are strongest, and will give much valuable information to owners of farm woodlots and others who plant trees for profit. Not until it is accurately determined just what species produce the strongest timber will it be possible to know just what trees to plant. When the report on tests is completed, information on the work will be gladly given to all who write to the Forest Service at Washington.

DISTRIBUTION OF LIGHT.*

By Otto Foell.

The illuminating engineer must be acquainted with the characteristics of the different light sources, so that he may be able successfully to take up problems that might be given to him for his consideration and advice. The first requirement is to know the amount of light wanted in a particular case, and an illuminant should be chosen which will not only allow of uniformity in design throughout an installation, but will also meet conditions to best advantage, from an illuminating engineering standpoint as well as from the point of operating expenses.

Generally, lamps are suspended from the ceiling, out of the direct vision of the eye. This is in accordance with an established principle of physiology, as the eye receives less strain when light is falling from above upon the surface which is to be illuminated. The lamps must be placed properly, with regard to distribution and candle-power; that is,

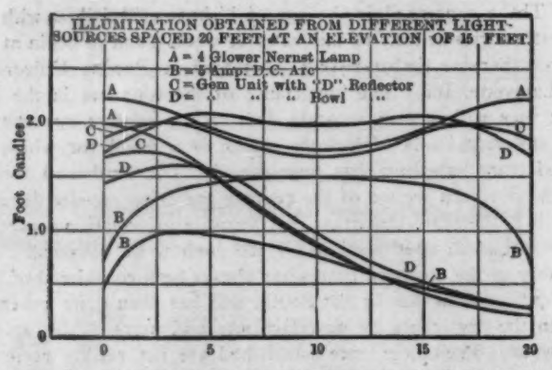


FIG. 1. ILLUMINATION CURVES FROM VARIOUS LAMPS.

they must not be placed indiscriminately, but their location must be chosen to obtain the desired effect. The distribution curve of a light source will give the illuminating engineer an idea of how to locate and space his lamps. It is natural, in large interiors, that the intensity of one lamp is reinforced by light falling from lamps in its immediate neighborhood. Taking this into consideration, the horizontal illumination, in a certain plane, is easily calculated. By moving the lamps one way or the other, that illumination may be secured which meets, as nearly as possible, the specified requirements.

The best way to study a distribution curve for artificial lighting is by comparison of the different illuminants. I shall therefore take up the characteristics of the newer light sources, and compare their illuminating efficiency by calculating the illumination produced by each lamp, in a horizontal plane. For example: A room fifteen feet high, with ceiling outlets spaced twenty feet apart, is to be illuminated so that the intensity of illumination in a horizontal plane, three feet from the floor, is about two foot-candles. In making this comparison, I assume that the room is illuminated, first by four-glower Nernst lamps, second by five-ampere direct-current arc lamps, third by 250-watt "Gem" high-efficiency incandescent lamps, two lamps to the outlet.

*Condensed from paper in Transactions of the Illuminating Engineering Society.

The illumination produced by two of each of these lamps, spaced as above, is given in Fig. 1, in which A represents Nernst lamps; B, arc lamps; C, the Gem high efficiency incandescent lamp equipped with bowl reflector, and D, the Gem high efficiency incandescent lamp equipped with distributing reflector.

Referring to the Nernst lamp, it will be noted that the illumination produced by one lamp varies from about two foot-candles below the lamp to two-tenths of a foot-candle about twenty feet away from the lamp. The illumination secured from two of these lamps results in a maximum lighting intensity of 2.23 foot-candles directly beneath lamps, and in a minimum illumination of 1.72 foot-candle between lamps; the average illumination secured by these lamps is 1.99 foot-candles, giving a total variation of .51 foot-candle, which is equal to 25.6 per cent of the average value of intensity.

Referring to the curve in Fig. 1, it is evident that all the light used for actual illumination is enclosed by a cone sixty degrees from the normal. The rest of the light is thrown in the upper zone, and is practically wasted, serving to illuminate side walls and ceiling. It is a good practice to keep the light

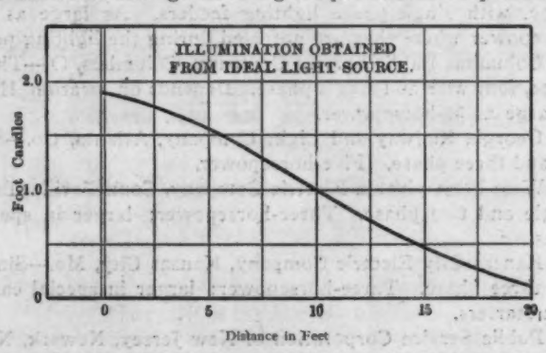


FIG. 2. ILLUMINATION CURVE OF IDEAL LIGHT SOURCE.

intensity on walls and ceiling low, say from .2 to .3 foot-candle, which is enough to relieve utter darkness, and whereby spotty effects are avoided. Only in special cases is it desired to have a brighter intensity on the walls, for instance, to bring out pictures or other decorations.

That means that practically all the light which is thrown, by illuminants, in a space above thirty degrees below the horizontal can be of very low candle-power to effect a good illumination. I have endeavored to draw a curve showing the illumination from a lamp as it should be, to produce a uniform illumination of two foot-candles under conditions mentioned. This curve is represented by Fig. 2. By comparison it will be seen that the intensity below, and twenty feet away from, the lamp should be about .1 foot-candle less than the normal four-glower lamp will give, while in the center between the lamps the intensity is somewhat higher.

The distribution curve derived from this ideal illumination shows that the light distribution should flatten out to some extent up to about forty-five degrees, where a maximum intensity occurs, and then the light intensity gradually diminishes until at about thirty degrees below the horizontal it is only about 46 per cent of the intensity directly beneath the lamp.

The perfect distribution curve, which would give uniform illumination in a plane twelve feet below lamps spaced twenty feet apart, is as follows:

0 degrees	100%
10 degrees	100
20 degrees	105.2
30 degrees	111
40 degrees	116.5
50 degrees	97
60 degrees	46

As stated previously, however, this curve, although giving uniform illumination, is not ideal, inasmuch as it does not provide general illumination throughout the room. Some light should be given out in the proper zones to make the room appear cheerful. This might be accomplished by so designing a lamp that its distribution not only allows uniform illumination in a certain horizontal plane, but will also throw enough light into the upper zones to get the effect needed in lighting interiors.

Referring again to Fig. 1, curve B, which shows the illumination obtained from an arc lamp, it will be noted that the contrasts are very marked, the illuminating intensity varying from .42 foot-candle directly beneath the lamp to 1.50 foot-candles midway between the lamps. The mean intensity obtained from these two arcs is 1.36 foot-candles. The total variation is 1.08 foot-candles, or 79 per cent of the average illuminating intensity. The illumination obtained is far less than the required two foot-candles.

The figures for arc lamps are results on lamps without reflectors, as in almost every case arc lamps are used that way; but usually with an opalescent outer globe, instead of the clear outer globe. While the opalescent outer globe might give a somewhat more diffused light than is obtained from the clear outer globe, yet the light intensity is less than that stated above.

An inspection of the distribution curve will clearly indicate that a very large amount of light is wasted by being thrown in a zone where it is not needed, and which makes a room appear poorly lighted by contrast, although the intensity of light in a certain plane comes up to the required amount. This effect has been pointed out by Preston S. Millar in a paper which he presented before the first annual convention of the society. He stated that in case of indirect lighting, double the amount of light is required for reading than is needed when the room is illuminated directly.

From the foregoing, I have come to the conclusion that the arc lamp is not very well suited for interior illumination, the character of its distribution being such that the light cannot be utilized to the best advantage, from an illuminating engineering standpoint, and because of the cost of operation.

To obtain the same effect as produced by a four-glower Nernst lamp, with high efficiency incandescent lamps, two lamps had to be placed to the outlet. The distribution from the incandescent lamps with bowl and distributing type reflectors, resulted in an illumination about the same as that of the Nernst lamp.

Referring to the curve, in Fig. 1, giving the illumination from Gem lamps with bowl reflectors, we see that the minimum is 1.67 foot-candles directly beneath the lamp, and 2.07 foot-candles five feet away from the lamp. These figures clearly indicate that the light between lamps equipped with the bowl reflector is greater than below the lamps, when lamps are installed as is customary. It has been claimed for this distribution that it practically affords uniform illumination. This is true only where lamps are spaced far apart and at a certain height. In that case, however, it is evident that the intensity of light is low. If a certain intensity of light is required, which will enable a person to work, lamps must be spaced closer together, and then the result will be a higher illumination between the lamps than directly beneath them. It is evident from this that the efficiency of a lamp having a distribution such as that given out by any incandescent lamp equipped with a bowl reflector is not the best, since the light decreases inversely as the square of the distance, and it is natural that a large amount of light must be thrown sidewise, which, if directed in a different way, might result in a more uniform illumination, and a more economical installation, in the number of lamps installed and for a given illuminating intensity.

The illumination from the Gem lamp, with distributing type of reflector, resembles that secured from the four-glower Nernst lamp, the only difference being that the maximum intensity of illumination is not directly beneath the lamp, but about three feet away from it.

The spacing of the lamps will change the illuminating intensity more or less, according to the character of their distribution. That is, the closer the lamps are spaced, the less uniform will be the illuminating intensity; the further the lamps are spaced apart, the less will be the light intensity; while the character of the distribution determines the uniformity. For an ideal illumination, the distribution curve around a lamp changes with the height at which the lamps are suspended, and with the distance the lamps are spaced. That is, no distribution curve can be determined which will give uniform illumination on all horizontal planes.

The examples given above are guides to what can be accomplished with a proper light distribution, and they show what is wasted from improper characteristics.

I want to point out very forcibly that it is a downward distribution which gives the most efficient lighting, as far as operating expense is concerned, and which also gives the most uniform lighting, by the application of such auxiliary devices as may be necessary to obtain that distribution curve which cannot be obtained from certain lamps by virtue of their construction.

This consideration brings to mind again the question of what is the proper way of rating and comparing illuminants. It is an established custom that the rating of any illuminant shall be according to its mean spherical candlepower. That is, by the total flux of light measured all over the surface of a sphere, with the light source in its center. However, I regard such a rating as wrong in principle, inasmuch as it does not give an idea of the value of a lamp for practical illumination, and furthermore, such a rating is wrong, generally speaking, because a light source may be of high spherical candlepower, yet when equipped with accessories to direct the light where needed, it is much lower in efficiency than a lamp which may give, by virtue of its design and construction, a better distribution.

I have pointed out, in the above examples, what an ideal distribution curve should be. All that is required is light in a zone, say twenty degrees below the horizontal, and for this reason the value of a light should be determined and compared on the basis of mean zonular candlepower, the zone to extend up to twenty degrees below the horizontal.

A man who provides illumination is not buying efficiency, but is buying light and that lamp will appeal to him as the best, which gives him the best illumination at the least expense to himself. Inasmuch as such a lamp must have a downward distribution, the only fair way to compare illuminants is to consider the illuminating power, and that is very well expressed by establishing a rating of mean zonular candlepower, or better, of mean hemispherical candlepower. This is in line with the proceedings of the German Electrical Society, which some time ago adopted such rating as the proper basis of comparing lamps.

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EDITORIAL.

CHRISTMAS GREETINGS.

The wireless telephone this week bears the immutable message of the Christmas spirit, "Peace on earth, good will toward men." The "Journal" joins in wishing forgetfulness of former cares and sorrows in the kindly celebration of the day, and the best of prosperity in the year to come to all its readers.

ENGINEERING BROTHERHOOD.

The recent action of the various great engineering societies of America, in seeking a common home in the newly completed Engineering Building in New York City, is but one step in the realization of the mutuality of their interests. The catalogue of one of our leading universities shows that twelve different engineering degrees are given to its graduates, and yet any one of these graduates is liable in his career to be called upon to perform the functions indicated by any or all of these degrees. His knowledge must not only be broad in general but must also be specific in its utilization. To be successful he must be greater than his occupation. But it is given to no man to know all; he must call for aid from others. Every engineer's work is closely interwoven and correlated with the work of others, not only in his own branch but also along other lines.

Taking as a concrete example an electrical engineer called upon to design a modern hydro-electric system, we find him first concerned with the water sources. For data he turns to the records of the government hydrographer. If such do not exist he must gather this information himself, or better still, employ a hydrographer to do it for him. Similarly the results of the topographic engineer's work must be studied before the tunnels, flumes, ditches and reservoirs can be planned. These water way installations are strictly in the domain of the civil engineer, who is here again differentiated from the type, who, as hydraulic engineers, design the turbine and attendant machinery, utilizing the water delivered.

Finally, when apparently in his own province of transforming mechanical force into electrical energy and transmitting the pressure of power to the purposed place, he finds that even as he has been preceded by the civil, so is he succeeded by the mechanical engineer in the devising of efficient power apparatus. Meantime, he must call upon the structural designer and the architect to prepare power plant plans, and upon the steam or gas man to design suitable auxiliaries, without which an electric system is neither complete nor economically perfect.

As a man seldom realizes the depth of a hole until he gets into it, so we find this list of needful helpers increasing as we progress. The calculations require the ability of the mathematician and the physicist in the realm of pure science, and the skill of the illuminating engineer is of use in that of applied work, which differs from the former in requiring an immediate rather than exact solution of its problems. Engineering is as truly scientific as any other branch of exact research; its success lies in correct interpretation of things seen, not in forcible fitting of facts to faculty formulas. Science classifies what we all know, engineering applies it for our own good.

In our discussion we have limited the field to current generation, without taking into consideration the great superstructure of the application of electricity to lighting, heating, lifting, mining, hauling, farming, fighting, talking, hearing, doctoring, and the thousand and one industrial usings of this progressive age. In order that this great structure be correctly contrived it should have the directive wisdom of cooperation among all factors in its building, strengthened by reciprocity and beautified by mutuality. The electrical engineer metaphorically strikes the rock of potential natural resources and literally causes the water to gush forth as an active achiever of our industrial civilization, if properly controlled and directed by the co-workers for the advancement of our material welfare.

Formulating foregoing facts into local necessities, we would urge the affiliation of all engineers with others of their kind, and of all kinds into an organization having as a common purpose the advancement of the common interests of its components, each contributing his little store of knowledge and experience to the common fund from which all may draw.

EXHIBITION COMMITTEE.

At the Washington Convention of the National Electric Light Association last June, the Class "D" members (manufacturers) of the Association made a most attractive exhibition of electrical apparatus and appliances. During the Convention these exhibitors got together and offered to relieve the Association of the troubles and responsibilities connected with the organization and maintenance of such exhibits at the annual conventions.

The Executive Committee of the Association approved a plan whereby the Class "D" members were to recommend annually an "Exhibition Committee" of Class "D" or "E" members. This committee, upon recognition by the president, would elect its own chairman, and organize to conduct the work pertaining to manufacturers' exhibits at the Convention.

A Nominating Committee was formally appointed, consisting of Mr. Geo. F. Porter (Chairman), Atlantic Insulated Wire Co., 120 Liberty Street, New York, N. Y.; Mr. T. G. Whaling, Westinghouse Lamp Co.; Mr. Alex Henderson, American Circular Loom Co.

The ticket presented by this committee to the Class "D" members has been approved by a mail ballot of Class "D" members and accepted by Mr. Dudley Farrand, President of the N. E. L. A. This committee, known as the "Exhibition Committee," is as follows:

Mr. F. H. Gale, General Electric Company; Mr. J. C. McQuiston, Westinghouse Companies; Mr. H. P. Heger, Allis-Chalmers Company; Mr. Rodman Gilder, Crocker-Wheeler Company; Mr. H. M. Post, Western Electric Company; Mr. C. P. Frey, Weston Electrical Instrument Company; Mr. Benj. Wall, Metropolitan Engineering Company; Mr. James I. Ayer, The Simplex Electric Company; Mr. S. E. Doane, National Electric Lamp Association.

On December 6th, the committee met in the Association rooms in New York, and elected Mr. F. H. Gale, Chairman.

A Committee on By-Laws and Rules for governing the committee was appointed, and preliminary plans regarding the Convention next June were discussed. The committee is, of course, subject to the Executive Committee of the Association, and will co-operate fully with the President and other officers in making arrangements for the Convention.

PERSONAL.

J. R. Harrington, of Santa Barbara, is in San Francisco.

Stone & Webster announce that all their offices in Boston, Mass., are now in their building at 147 Milk Street, corner of Battermarch.

R. C. Bowdish is said to have been made general superintendent of the Coeur d'Alene & Spokane, with offices at Spokane, Wash.

W. F. Lamme, electrical engineer for the Westinghouse Electric & Manufacturing Company, is in Goldfield, after a short stay in San Francisco.

TRADE NOTICE.

The Wisconsin Engine Company of Corliss, Wis., has been awarded the contract for a 20,000,000-gallon vertical triple expansion pump for the city of Atlanta.

TRADE CATALOGUES.

Single-stage, motor driven, centrifugal pumps built for any capacity and condition of service within the range of their adaptability are described in Allis-Chalmers Company's Bulletin No. 1608.

The November number of "Holophane" presents interesting installations of the Holophane system of illumination in an armory, church, and store, and also readable text of this progressive company's doings.

H. W. Johns-Manville send an Asbestocel leaflet on "How to Get More Heat With Less Coal," also a booklet illustrating and describing the Electrotherm, which takes the place of the hot water bottle.

Monthly Bulletin of the Ohio Brass Company, of Mansfield, Ohio, contains an illustrated description of the single-phase railway between Visalia and Lemon Cove, California. This, together with the usual snappy material, makes interesting reading.

The General Electric Company, Schenectady, N. Y., has perfected a simple and substantial single phase motor, known as Type IS, Form KG which is described in Bulletin No. 4545. The bulletin illustrates various sizes, describes the details of construction and operation, shows forms of starting boxes, and gives a large amount of general information, useful and important to power users.

The Wagner Electric Mfg. Co., of St. Louis, sends a pamphlet entitled "The Polyphase Motor in the Shop." This is a description of the repair shops of the Wabash R. R. Co., at Decatur, Ill., which installation is driven by Wagner three-phase motors exclusively. The tables given show the power required to drive certain machines, and the average load put upon them by certain classes of work, and are made up from actual tests on the machines while working under normal manufacturing conditions.

The National Electric Contractors' Association of the United States and the American Institute of Architects have issued a chart of standard symbols showing various outlets, fixtures and other wiring devices. The General Electric Company, Schenectady, N. Y., has just issued a little booklet giving sample plans of an office or accounting room, and of a kitchen and dining room in which the symbols are illustrated. The other pages of the brochure are used to illustrate and describe many of the G. E. specialties indicated by the symbols in the plans. Among the specialties mentioned are key sockets, "Security Snap" pendant sockets, ceiling rosettes, cabinet panels, wireless clusters, snap switches, flush pocket wall receptacles, floor outlets, receptacles for heating devices, lamp receptacles, combined switch and cutouts, etc.

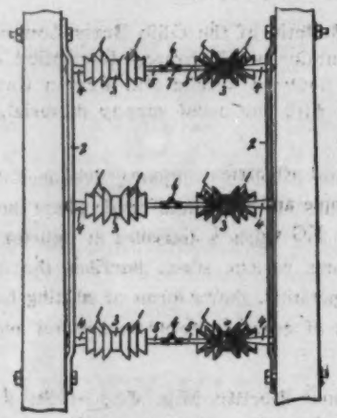
OBITUARY.

Lord Kelvin, better known to many as Sir William Thomson, and affectionately called "the father of electrical engineering" died December 17th, at Glasgow, from complications following a severe chill. He was born at Belfast in 1824 and was professor of natural philosophy in the University of Glasgow from 1846 to 1899. He was knighted in 1866 for his work in connection with the Atlantic Cable, and in 1892 he was raised to the peerage. He leaves no heir and his title becomes extinct. Lord Kelvin was one of the foremost scientists of the age and the world has suffered a loss in his death that is compensated only by the value of the work he has left.

PATENTS

SYSTEM OF INSULATION FOR HIGH-VOLTAGE ELECTRIC CONDUCTORS. 872,569. Fred M. Locke, Victor, N. Y.

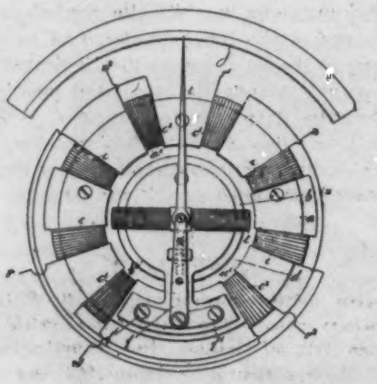
A system of insulation for high voltage electric conductors comprising a plurality of pairs of insulators, those of each pair being arranged end to end, metal bands encircling



adjacent ends of the insulators of each pair, each insulator comprising a series of petticoat sections nested together, those of each pair having their opposite ends facing in opposite directions, and center pins entering the open ends of the center sections of each insulator.

ELECTRICAL MEASURING INSTRUMENT. 872,474. William E. Sumpner, Birmingham, England.

An instrument for indicating electrical phase relations, comprising an outer iron core, an inner iron core, a conductor capable of movement in the air gap between the cores, coils which when appropriately energized produce in such air gap



a rotary field whose frequency and phase depend on one of the two quantities whose phase relation is to be indicated, means for supplying the movable conductor with a current whose frequency and phase depend upon the other of such quantities and means for changing by a definite amount the mutual phase relationship of the produced field and the current in the movable conductor.

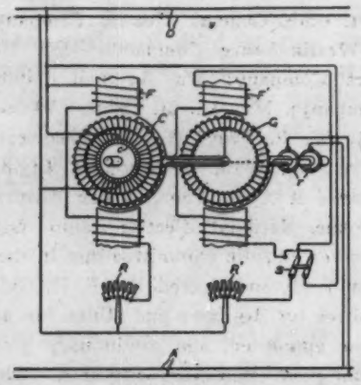
TUNGSTEN ELECTRIC INCANDESCENT LAMP. 872,936. John A. Heany, York, Pa.

The combination of a plurality of fine hair-pin shaped filaments of dense but fragile refractory metallic material connected in series, and a support for filaments within a

vacuum bulb with suitable current connecting wires for series of filaments, support comprising a plurality of spiral springs, each of which engages a filament at the loop thereof, and an additional steadying means located between springs and the other end of each filament.

CURRENT-CONVERTER. 872,549. Leonard Wilson, Schenectady, N. Y., assignor to General Electric Company.

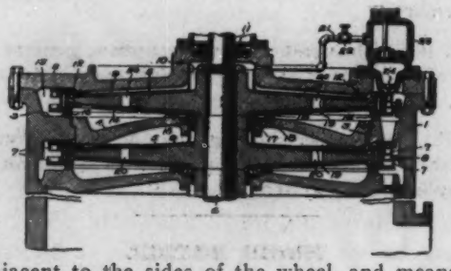
In a converter from direct to alternating current, a rotary converter having its armature arranged to be supplied from the direct current source through a commutator, an alternat-



ing current generator mechanically connected to rotary converter and having its armature in series with fixed points on the armature winding of the rotary converter, collecting means in series with both armatures, and means for independently varying the field-strength of both machines.

TURBINE. 872,545. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Company.

In an elastic fluid turbine, the combination of a bucket wheel, a casing therefor containing a main chamber for the wheel, admission and exhaust conduits, stationary walls lo-



cated adjacent to the sides of the wheel, and means for introducing fluid into the auxiliary chambers formed between the wheel and the walls at a temperature above that of the fluid passing through the wheel buckets to reduce the rotation losses.

CURRENT COMMENT

The "pay-as-you-enter" cars, recently put on the Chicago City Railway, are reported as being eminently satisfactory after nearly a month's trial, since November 24th. These cars have been in use in Montreal since June, 1905, and are soon to be introduced in New York, Buffalo and Jersey City.

Illuminating Engineering Society has nominated as officers for 1908, Dr. Louis Bell, Boston, President; Arthur Williams, New York, C. E. Stephens, Pittsburg, Vice-Presidents; W. H. Gartley, M. K. Eyre, Bassett Jones, Jr., Directors; V. R. Lansingh, General Secretary; Dr. A. H. Elliott, Treasurer.

To de-magnetize a watch, hang it to a string and twist the string so as to rotate the watch rapidly near the pole of a strong magnet. While it is whirling, gradually take it away from the magnet. The method used for de-magnetizing with alternating current consists of a coil of wire with a hole in the center large enough to admit a watch, the coil being connected to a source of alternating current, and when the watch is dropped in and pulled out, it is de-magnetized.

Tokio, Japan, has ninety miles of electric railways, exclusive of suburban lines, all under the management of one Japanese company. The 700 cars in daily use carry an average of 300,000 passengers, and have already displaced more than half the jinrickshaws. A 2½ cent fare and complete transfer system is in force, but as yet there are no unions. Wages are on a minimum basis of $6 per month for both conductor and motorman. The track is narrow gauge, owing to the narrow streets. All the cars, etc., are made in Japan, from American and European ideas.

The Rosenberg generator, American patent rights of which have been acquired by the General Electric Co., will deliver a constant current at variable speed and a constant output at constant speed. This is done by short-circuiting the usual service brushes and placing the actual service brushes midway between them on the commutator. Any increase in current increases the magneto-motive force opposing the primary flux, and can be designed to give either a constant current or a falling voltage with rising current for search-lights and electric welding. It is also applicable to gasoline-electric conveyances, and also as a reversible booster between two sources of variable voltage.

The Societe Electrometallurgique, which has applied the electrometallurgical processes of Paul Girod, has now in operation plants in France and Switzerland consuming 14,000 kilowatts of electrical power, all of which is produced by water power. A fourth plant of 5000 horse-power will be completed this year, and when other water powers in the Alps owned by this company are developed, the total electrical power available will be raised to over 40,000 horse-power. The productions of this company consist of ferro-chrome, ferro-tungsten, ferro-molybdenum, ferro-vanadium and pure vanadium, ferro-silicon, titanium and ferro-titanium, ferro-manganese, cupro and nickel vanadium, silico-chrome, silico-manganese, ferro-boron, ferro-tantalum, ferro-uranium, cupro-silicon, etc. The largest products are, in the order named, ferro-silicon, ferro-chromium and ferro-tungsten; 6000 tons of the former were produced last year. The total sales amount to about $2,000,000 per year.

The United States Civil Service Commission announces an examination on January 15-16, 1908, to secure eligibles from which to make certification to fill four vacancies in the position of aid in the Coast and Geodetic Survey, at $720 per annum each. The examination will consist of the subjects mentioned below:

1. Mathematics (including geometry, plane and solid, algebra, trigonometry, analytics, and the elements of calculus). 2. Practical computations (involving the use of logarithmic tables). 3. Astronomy (elementary questions in spherical and general astronomy, with special reference to determination of latitude, longitude, and azimuth, and the use of field instruments). 4. Physics (elementary questions in optics, magnetism, etc). 5. Surveying (elementary questions in plane and geodetic surveying, and use of field instruments). 6. Modern languages (competitors may select one of the following: French, German, Spanish, Italian. Extracts of about 100 words are given for translation into English). 7. Drawing and descriptive geometry (a short test in topographic drawing and lettering is given with elementary questions on the principles of projection).

Electrical devices are the subject of fifty in a list of 700 patents in the latest issue of the U. S. Patent Office Gazette. Fourteen of these fifty are assigned to one electric company. This gazette is issued weekly and the latest issue but exemplifies the fact that more ingenuity is being exercised on electrical subjects than upon any other. According to a statement published by a German paper, about 5,000 different electrical patents are granted every year in the various civilized countries. Of this total only about 900 enjoy legal protection in Germany, and 200 of the latter patents are issued to foreigners. The remaining 4,100 patents can be freely used in industries, as the individual inventors do not claim any special protection in Germany. The patents granted to persons living in the countries concerned are stated to have been as follows in the years 1904 to 1906: The United States, 2,050; United Kingdom and Colonies, 750; Germany, 700; France, 400; Austria, 200; Italy, 180; Hungary, 130; Switzerland, 120; Belgium, 90; Sweden, 90; Denmark, 90; Spain, 35; Australia, 35; Norway, 30; Portugal, 15; total, 4,915. The German journal remarks that the patents issued to foreigners in the different countries are mainly repetitions. Russian patents have been left out of consideration. The publication takes place in that country before the granting, which is about three or four years after the application.

When iron is suddenly submitted to a magnetising force an appreciable time is required for the magnetisation to reach a steady value. The slope has been shown by Martens and Klemencic to consist of two parts, one corresponding to an extremely rapid, and the other to a comparatively slow change; and between these parts there is a "pause." The slow change has been frequently examined, but the rapid change has been dealt with by only a few experimenters. It requires very accurate measurement of the short interval of time between opening and closing the magnetising circuit. Martin Gildemeister has for this purpose made use of a Helmholtz pendulum of great precision, and a micrometer contact-screw. His observations were taken in respect of a bundle of very thin wires, and he considers the value of (1) the sudden current at breaking the circuit, due to the induction of the coil; (2) the current due to the growth of magnetisation in the iron; (3) the current due to the capacity of the coil. As a result, he concludes that the rapid change of magnetisation of the thin iron wire falls to half its value in one three-hundred-thousandth of a second. It diminishes to one-tenth of its original value in one one-hundred-and-fifty thousandth of a second; and it vanishes altogether in one fifty-thousandth of a second. From one fifty-thousandth to one two-thousandth of a second the magnetisation of the iron remains appreciably steady; this constitutes the "pause." These results appear to us to be of considerable importance in their bearing upon telephony, and upon the design of the rapidly moving parts of high-speed telegraphic apparatus.

INDUSTRIAL

ALLIS-CHALMERS LIGHTING TRANSFORMERS.

In view of the record made by Allis-Chalmers Company's power transformers, it was to be expected that the transformers built by that company for lighting service would be equally satisfactory, and such has proven to be the case. These transformers, designed for operation on 1050 or 2100-volt primary circuits, are made in sixteen sizes, ranging from .6 kilowatts to 50 kilowatts. They are intended for lighting work on a normal frequency of 60 cycles per second, but can be operated on any frequency from 50 to 140 cycles, the efficiency being somewhat better on the higher frequency than on the lower. They can also be operated at 10 per cent above or below normal voltage, but all standard data regarding efficiency, regulation, etc., is based on operation at normal voltage of 1050 or 2100, and normal frequency at 60 cycles.

Being of recent design, they include all the features that have proved most advantageous for lighting work. Not only are the best materials used in their construction, but special care has also been taken to secure thorough and permanent insulation between primary and secondary coils, as well as between the coils and core.

These transformers are of the so-called "core" type, the magnetic circuit of which is in the form of a laminated core passing through the coils; the coils thus surround the core, whereas in the "shell" type the coils are for the most part surrounded by the iron. The cores of Allis-Chalmers lighting transformers are made of the best quality of iron obtainable, especially selected for the purpose, and annealed to reduce the core loss to a minimum. Alternate laminations are varnished on both sides with a special varnish unaffected by the oil in which the transformer is immersed; this effectively insulates the punchings and prevents eddy current loss. Nor does the core loss increase appreciably with long continued use, as the iron is carefully selected in the first place and the transformers are designed for operation at moderate temperature. In building up the cores, a duct is left between the laminations in all except the smaller sizes, thus providing a passage through which oil can circulate and carry off heat from the core.

The coils are wound on the two sides of the rectangular iron core, the secondary being placed next the iron. The primary and secondary are subdivided so as to reduce magnetic leakage to a minimum and thereby secure close regulation. The coils are impregnated with insulating compound after they have been first thoroughly dried out in a vacuum. The insulation between the coils and core, also between primary and secondary, is prepared from fuller board and mica, which are unaffected by oil. This insulation is approximately cylindrical, and has no sharp bends to cause weak points liable to breakdown. The coils are thin, and so designed that the circulation of oil will carry off the heat from all parts of the windings; in no case is the copper more than one inch from the oil.

The terminals of the high voltage windings connect to a porcelain terminal block allowing the primary coils to be readily connected in parallel for 1050 volts or in series for 2100 volts. Changes in secondary connections are made outside the case by joining up the leads to the secondary mains so as to give the required series or parallel combination.

Both primary and secondary leads are of flexible rubber covered cable treated so that it will not syphon the oil. They pass into the case through porcelain busings, into which they are securely cemented.

For transformers from .6 kilowatts to 15 kilowatts the cases are of cast iron with removable cover held in place by eye bolts. The larger sizes, from 20 to 50 kilowatts, have corrugated sheet iron cases with cast iron top and bottom. The corrugated sheet metal cases are used on the larger sizes

because they are much lighter and easier to handle than cast iron, and present a larger cooling surface. The tank is entirely separate from the cast iron top and bottom, and is made of heavy terne sheet. It is perfectly oil tight, and is so mounted that the whole transformer can be handled without straining the tank in any way. The tank rests on a cast iron base, and is covered by a cast iron top connected to the base by rods which take the strain when the transformer is lifted by the hooks cast on the top. The top is provided with a cast iron cover to give access to the terminal block. All cases are thoroughly weatherproof and suitably painted.

Each transformer is supplied with enough oil to immerse the coils and core. This oil has been selected as the result of a great many tests on insulating oils, and it has a high flashing point and great di-electric strength. The insulation on the coils is, in itself, able to withstand potentials much in excess of the ordinary working pressure, but the oil offers an additional protection, and also serves to conduct the heat from the core and windings to the outer case, thus insuring low temperature rise.

Each transformer is furnished with hanger hooks for cross-arm suspension. Eye bolts or hooks on the transformer cases are also provided for convenience in handling and mounting on poles.

Two single-pole primary fuse blocks are furnished with each transformer. These are of standard type, made of porcelain and provided with removable fuse holders.

These transformers have high efficiency, and care has been taken in their design to reduce all losses to the lowest practicable amount consistent with reasonable cost. The copper and iron losses have been carefully proportioned to secure high all-day efficiency on lighting service. Standard efficiencies are based on operation at 60 cycles and 1050 to 2100 volts primary. For higher frequencies the efficiency will be slightly higher on account of reduced core loss, while on lower frequency the efficiency will be somewhat reduced.

Owing to the manner in which the coils are arranged, the leakage flux in these transformers is reduced to a minimum, thus keeping down the reactance drop. The drop due to the resistance of the coils is limited by winding them with wire or strip of liberal cross section. The result is that the regulation is very close, and the secondary voltage varies but slightly with changes in load, assuming that the primary pressure remains constant.

Transformers of from 3 to 50 kilowatt capacity can be operated on the three-wire system with unbalanced load. With normal full load current on one side and zero on the other, the regulation is equal to the quaranteed regulation given in the tables.

The primary windings are arranged for 1050 or 2100 volts. The smaller transformers, .6 to 2½ kilowatts, have secondaries wound for 52.5 or 105 volts; the larger sizes, 3 to 50 kilowatts, have secondaries for 105 or 210 volts.

Those transformers are designed to operate at moderate temperatures, thus avoiding deterioration of insulating material and ageing of the iron. They will carry full load continuously with a temperature rise not exceeding 45 deg. C.

The insulation of all Allis-Chalmers transformers is subject to a high potential test to insure that no defects have occurred in manufacture. An alternating E. M. F. of 10,000 volts is applied between high voltage and low voltage coils, and between high voltage coils and iron, for one minute. Between the low voltage coils and iron an E. M. F. of 2000 volts alternating is applied for one minute. In addition to this, each transformer is run for five minutes at three times normal voltage, thus subjecting adjacent turns and layers of the winding to three times normal pressure and insuring reliable insulation in all parts of the coils.

NOVEL USE OF ELECTRIC FLAT IRONS.

It is not often that heating units from electric flat irons are put to as severe a test as in the instance given below. The problem was to replace a crank pin on the high pressure side of a 500 horsepower cross compound Russell engine. The new pin was 6 inches in diameter, with a taper of 1-64 inch, and had to be fitted tightly into the disk, which was 5 inches thick, with a 12-inch shaft. To expand the disk by heating it with blow torches would have taken too long, besides making a dirty and unsatisfactory job, so several heating units from General Electric 6-pound flat irons were grouped around an iron core 3¼ inches in diameter and placed in the 6-inch hole in the crank disk. In four hours after the current was turned on the disk had expanded sufficiently to allow the crank pin to slip in. Although the heating units were at about white heat all of the time, they were not injured except that the brass tubing on two was slightly melted in one place. The heating units were replaced in the flat irons and have been in use for the last three months, one of them being in a laundry where their active service averages forty hours each week.

CORRESPONDENCE.

The Editor,

Sir: Please refer to the issue of the "Journal" for November 16, 1907, and note that in connection with an article entitled "Efficiency Test of an Electric Pumping Plant," the following figures are in error:

On page 421 in the table entitled "Hydraulic Power Summary," column entitled "Working Head" now reads 119.7, should read 186.43; now reads 123.3, should read 190.38.

Column headed "H. H. P." now reads 24, should read 33.4; now reads 21.32, should read 31.7.

In the table headed "Efficiencies," following this under the head "Plant Efficiency," now reads 25.8, should read 36.9; now reads 23.8, should read 35.4; now reads 23.4, should read 33.4.

Column headed "Pump Efficiency" now reads 32.5, should read 45.2; now reads 29.7, should read 44.2.

Column entitled "Head" now reads 119.7, should read 186.43; now reads 123.3, should read 190.38.

J. G. DE REMER.

San Francisco, December 13.

R. W. Hersey, of San Jose, Cal., has been granted a permit by the Forest Service to occupy a right of way on the Stanislaus National Forest, and to construct thereon a transmission line for transmitting electric power for commercial purposes. The line will be located about twenty miles southwest of Sonora, beginning at the Tuolumne Electric Company's power house in the NE ¼ of the SE ¼ of Sec. 6, T. 1 S., R. 17 E., M. D. M., and running in a northwesterly direction through said Section 6 and Section 31, T. 1 N., R. 17 E., M. D. M., to a point near the northwest corner of said Section 31. The line will furnish electricity to the towns of Tuolumne, Soulsbyville, Confidence and Carter.

NEWS NOTES

TRANSMISSION.

Hanford.—Bids will be received up to January 10th for an electric power franchise applied for by the Mount Whitney Power Company.

Oakland.—Bids for a franchise for the installing of an electric power wire and pole system as proposed by E. M. Downer of Contra Costa County, have been asked for by the Board of Supervisors.

Oroville.—Advices from Oroville state that General Superintendent E. S. Dimmock of the Northern Electric Company has been relieved. It is known that Mr. Dimmock has a five-years' contract with the company for employment as general superintendent of the Northern Electric. The rumor is persistent, however, that an adjustment will be effected that will mean his retirement.

Oroville.—The Oro Water, Light & Power Company has completed eight miles of ditch for its new power plant at Humbug Valley, Plumas County. This ditch will carry 3000 miners' inches of water. The water will have a fall of nearly 2000 feet almost perpendicularly. The company can increase its capacity by a storage reservoir, for which the lower end of Humbug Valley is an ideal site. Over 50,000 horse-power of electric force can be generated at Humbug.

Grass Valley.—Owing to the inability to obtain sufficient power at all times, the Sultana Mining Company is planning to build an electric power plant of its own on its holdings near Grass Valley. Experts are now working out a system which is expected to cost $20,000. The Sultana depends altogether on electricity for power, and when the Bay Counties Company happens to be short somewhere else, the mine suffers.

Oroville.—The Great Western Power Company is rushing work, and if all goes well the new tunnel will be completed, with the exception of the cementing, in four weeks. It is also expected that power will be produced by July next. The work is to be completed in two sections, and it is the first section that it is hoped and now expected will be completed by July. The specifications for this section contemplate the construction of a plant that will produce power to the extent of 50,000 horse-power. It will be a year and a half before this is completed.

Fairfield.—E. D. N. Lehe, of Dixon, recently spent a day interviewing residents of Suisun Valley on the subject of supplying them with electricity for light and power. He met with great encouragement, and has concluded to build a line up the valley from the substation near Cordelia. The line will run to the Willotta ranch and then to other places where there is demand. It is not probable that he will cross the Suisun Creek with the line, as Leonard Prior, of the Suisun Light & Power Company, is understood to have the exclusive right from the Bay Counties Power Company to furnish light and power in Suisun township.

Oroville.—Three of the largest transformers known in the electrical industry are being manufactured for the Great Western Power Company of California by the General Electric Company of Schenectady, N. Y. The ultimate head of water developed will be 626 feet, and 40,000 horse-power will be transmitted at 100,000 volts to points along the Coast 165 miles distant. The total weight of each of these transformers will be 128,000 pounds; of this weight 40,000 is due to the 5000 gallons of oil used in each machine for cooling and insulating purposes. Each transformer is in the shape of an oval, stands twenty feet above the floor and measures 9x18 feet. When these transformers are in operation they will each transform 14,000 horse-power of electrical energy from a low voltage to a high voltage at the remarkably high efficiency of 98.6 per cent.

OIL.

Los Angeles.—The Rosario and Descanso ranches, located in Lower California, Mex., have been sold to a California syndicate for $300,000. Oil has been found on this property recently, which is said to be an illuminating oil of unusual quality. Asphaltun has also been found. Wells will be drilled and the property colonized by the syndicate company.

Los Angeles, Cal.—The $1,500,000 used in developing the south field of the Coalinga Oil District has not been sunk in vain, according to late advices, which state that the Associated Well No. 5 is now flowing more than 150 barrels a day, notwithstanding the fact that the casing has not yet been landed. The only other well operated is yielding 800 barrels a day.

Bakersfield, Cal.—Seventy-five-cent oil is the talk now among the members of the Independent Sales Agency, and it is certain that when a new contract is entered into next month the figure will be somewhere above 50 cents and may reach the price named. The present quantity contract will have been filled by the middle of December and sometime in the early part of this month bids will be received for the oil controlled by the agency for another year. The oil will, of course, go to the highest bidder, whether it be the Associated or the Standard. A well-known producer has said on the situation: "The storage oil is about exhausted and the marketers must depend upon the daily production at the wells to meet the wants of the consumers. This means that the price will necessarily advance. Many members of the agency think that the figure should be as high as 75 cents, and nobody talks less than 50 cents. It is likely, however, that the price will be considerably in advance of that figure; I should say somewhere between 60 cents and 75 cents."

TELEPHONES.

Eugene, Ore.—Dr. Johnson is organizing another local telephone company at Waterville.

Aberdeen, Wash.—The Wynooche Telephone Co. was granted a franchise over the County Road, from the Givens to the Askew ranch.

Meteor, Wash.—R. R. Coleman has received orders to install a telephone from Meteor to Daisy. He expects to have it in operation in a short time.

Tacoma, Wash.—Last Wednesday's gale and the trouble from the electric light wire combined, put about 1,000 of the Sunset phones out of commission. Nearly all the country lines were down, and the long-distance system was crippled.

Washington, D. C.—Plans have been approved by the Secretary of War for the rebuilding of the telegraph wires on the Yukon River, the construction of a second wire between Fairbanks and Valdez, and sections of wireless telegraph lines, and improvement and extensions to the cable lines.

Kendrick, Ida.—F. W. Smith, the engineer of the Interstate Telephone Company, is in town with a crew of men, putting in the new metallic system. They have just finished in Troy, and are now fixing up here, so that in the spring they can connect the long-distance on without being delayed.

Georgetown, Wash.—Because of the alleged bad service furnished Georgetown by the Sunset Telephone Company, J. W. Doyle, a member of the Council, says he will introduce a resolution at the meeting of that body Wednesday asking the Independent Telephone Company to extend its system into the town.

Dayton, Wash.—Another rural telephone line is being built, extending from Dayton to the George Crider place, a distance of about eight miles. The wire will be strung on the Cahill poles as far as the Abels' place, and new poles set from there on. The parties interested in the new line are Dave Barclay, George Crider, Will Kendall, Arthur McCubbins and Del Thompson.

Aberdeen, Wash.—President Finch of the Chamber of Commerce, who a year ago secured franchises from the Council to put in an independent telephone system in this city and Hoquiam, has been trying to finance his scheme since then and in the meantime endeavoring to keep his agreement in both cities and save a cash bonus of $1,000. So far Mr. Finch has successfully defeated all attempts to declare his franchise forfeited and if the present financial trouble clears may be able to pull his plan through to successful operation.

Sunnyside, Wash.—The stockholders of the Yakima Valley Telephone Company elected the following trustees for the ensuing year: W. P. Sawyer, George H. Irish, A. C. Webber and S. J. Harrison. The trustees organized with S. J. Harrison, president; W. P. Sawyer, vice-president, and Roy C. Lichty, secretary and treasurer. They ordered a new switchboard and new rooms for the Sunnyside exchange. They also ordered the intercommunicative systems installed in the smaller towns of the valley.

Bellingham, Wash.—Extensive improvements were started on the system of the Sunset Telephone Company, by which the service in the northern part of the city will be improved. Manager Reno announced that the improvements will cost $15,000, and that it will take three months to complete the work. Of this amount, $2,500 will be for labor and the rest for material. On Elk Street the wires are to be taken from all the poles between Magnolia and James Streets and cables will be strung. In all 6,000 feet of cables will be placed on the lines this winter in addition to that already in use. One hundred poles also will be placed.

Centralia, Wash.—B. E. Clements, who three months ago obtained a franchise for a telephone line in Centralia, and who was to have commenced work on the system on or before December 1st, made application for a six months' extension of time in which to commence work. He did not ask for an extension of time in which the system should be completed. After some discussion, Mr. Clements was given until April 1st, 1908, in which to begin work on his telephone system, and must have it in operation within one year from the time he obtained his franchise. Mr. Clements claimed that on account of the recent financial flurry, he was unable to secure the necessary funds with which to construct his line.

WATERWORKS.

Los Angeles, Cal.—The Board of Public Works has awarded the contract for furnishing and laying a riveted-steel penstock for the Los Angeles aqueduct, to the Lacy Manufacturing Company, at $18,529.10.

Santa Cruz, Cal.—Proposals will be received up to December 20, for furnishing the city with 100 water meters, as follows: Seventy-five ⅝-inch, with couplings; fifteen ¾-inch, with couplings; seven 1½-inch, with couplings; and one 2-inch, with coupling.

Woodland, Cal.—The Board of City Trustees met in a special session recently, to open bids for furnishing about 23,000 feet of pipe, iron gates and other fixtures necessary to extend the water system. J. A. Murray's bid of $7,994.90 was the lowest, and the contract was awarded to him. It is estimated that the digging and laying will cost $1,500.

Oakland, Cal.—The People's Water Company, of Oakland, is pushing ahead its improvements. A contract has been awarded to the Allis-Chalmers Company for a new steam pumping plant of three units, which will be delivered in a short time. The contract includes the installing of these pumps in a new pumping station, near the water front on Twenty-third Avenue, in East Oakland. The specifications called for three horizontal cross-compound flywheel type condensing engines, each having a capacity of 8,000,000 gallons in twenty-four hours. Each pump will have cylinders fourteen and thirty inches in diameter by thirty-inch stroke. The steam pressure to be carried is 170 pounds, and the speed of the pumps is fifty-five revolutions per minute. The normal capacity of the entire plant is to be 24,000,000 gallons, pumped to a height of 348 feet in twenty-four hours.

TRANSPORTATION.

San Bernardino, Cal.—The Council has adopted an ordinance giving a franchise to C. S. Chestnut, covering certain streets with an electric right of way.

Napa, Cal.—The Webster Stone surveying party is at work in the vicinity of Soscol, south of Napa, making surveys for the new Napa & Lakeport electric railroad.

Redlands, Cal.—The proprietors of the marble quarry in Mill Creek Canyon above Forest Home, are considering the building of an electric railroad to get the marble down the mountain to the wagon road.

Elmhurst, Cal.—The presence of a party of surveyors running a line through this place has revived the talk of another electric railroad through the suburban section. The Southern Pacific Company is mentioned as the party.

Boulder Creek, Cal.—The Ocean Shore has let a contract to Geo. Pratchner for grading its branch from the coast up Scott's Creek to Swanton, and there is every indication that this line will later be extended to the State Park.

Bisbee, Ariz.—A. R. Malone of the Warren Townsite Company and Chas. G. Adsit, the company's electrical engineer, have left for Chicago to select cars for the new electric railway which is about completed between Warren and Bisbee.

Mountain View, Cal.—The electric line from Los Altos to Mountain View has been decided upon. In an interview W. A. Clark stated that the capital was secured for the building of the line from Mountain View station to Los Altos, three miles in length.

Oakland, Cal.—The Oakland Traction Company has opened its new line to Alameda. The cars start from Thirteenth and Washington Streets, Oakland, and run via Thirteenth Street, East Fourteenth Street and Park Street to Santa Clara Avenue, Alameda.

San Diego, Cal.—H. W. Keller and W. G. Kerchoff of Los Angeles and Ed. Fletcher of San Diego are the interested parties in a franchise for electric lines at San Diego, under the terms of which $50,000 must be spent in actual construction by January 1, 1908. As far as can be learned, nothing has been done to maintain this city grant.

San Francisco.—Mayor Taylor has instructed the Chief of Police to prevent the United Railroads from erecting poles or stringing wires on Pacific Avenue, westward from Polk Street, during the night. The action is to assure against the conversion of the city's cable lines into overhead trolley lines, under the rights conferred by the so-called general "overhead trolley franchise."

Napa, Cal.—The Southern Pacific, through its attorneys, F. E. and L. E. Johnston, has filed a suit in the Superior Court at Napa, asking that the San Francisco, Vallejo & Napa Valley Electric Road be permanently enjoined from cutting and crossing over the rails of a spur track of the plaintiff's line on Main Street, St. Helena. The judge has granted the Southern Pacific a temporary injunction and cited the electric road to show cause why the restraining order should not be made perpetual.

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